REMARKS

Claims 1-30 are pending in the application. Claims 1-30 stand rejected. The Examiner indicated that the signature for one of the inventors, Jonas Sidaravicius, is unclear and distorted. Applicants are endeavoring to obtain a supplemental oath/declaration from Mr. Sidaravivius, showing a clearer signature of the inventor. This will be filed as soon as it is available.

The pending claims stand rejected. Applicants respectfully request reconsideration of the rejections based on the following comments.

Rejections Under 35 U.S.C. §112, first paragraph

The Examiner rejected claims 1-30 under 35 U.S.C. §112, first paragraph, because the specification did not provide enablement for charge transport compounds and the devices, articles, and processes containing these compounds where the structures of R_3, R_4, R_5, R_6, R_7, R_8, and R_9 are specified as a part of a ring. With respect to the term "part of a ring group", Applicants submit that one of ordinary skill in the art would understand that part of a ring group is an atom or group that is bonded to other atoms or groups in a ring. Further, in Applicants' previous response, the use of two R groups (e.g. R_4 and R_5) was provided merely as an example and not as a limitation that two R groups are required to form the ring. One R group forming part of the ring is necessary, along with other atoms or groups in the compound structure, but not necessarily other R groups. This is in **contrast** with embodiments in which an R group is a ring group, such as a phenyl group, or comprises a ring group, such as a benzyl group. Part of a ring group is clearly only a part rather than an entire ring group. This indicates clearly that another part of the ring is also bonded to the indicated structure.

The specification indicates, on pages 22-23, that R_3, R_4, R_5, R_6, R_7, R_8, and/or R_9 may be part of a ring, but does not limit which are the other components of the ring. As noted in the response, as one example, the ring components could derive from R_4 and R_5. However,

dependent upon the precursors used in the synthesis, the other ring components (other than R_3, R_4, R_5, R_6, R_7, R_8, and/or R_9) can be provided by the compounds selected to participate in the synthesis. The examples provided in the specification are not intended to be exhaustive, and do not limit the possible compounds synthesized from including compounds wherein an R group selected from R_3, R_4, R_5, R_6, R_7, R_8, and/or R_9 may combine to form a ring.

One of ordinary skill in the art would be able to use the general synthetic approaches described in the specification to select the appropriate reactions to form the desired ring(s). A charge transport compound could be formed wherein an R group forms part of a ring along with available sites on the basic structure and/or branches. Thus, the specification enables one of ordinary skill in the art to make and use the invention commensurate with the scope of the claims.

Applicants respectfully request the reconsideration and withdrawal of the rejection of claims 1-30 under 35 U.S.C. §112, first paragraph.

Rejections Under 35 U.S.C. §112, second paragraph

The Examiner rejected claims 1-30 under U.S.C. §112, second paragraph, as being indefinite for failing to particularly point out and claim the subject matter which Applicants regard as the invention. The Examiner indicated that the instant claims remain indefinite in the definition of R_3, R_4, R_5, R_6, R_7, R_8, and R_9 as "a part of a cyclic ring." Further, the Examiner indicated that such an incomplete structure does not particularly point out and distinctly claim the invention because it is unclear how such a partial structure defines, with the other components, a charge transport compound

Applicants have attached to this response several web print-outs relating to the term "part of a ring". As used throughout the attached print-outs, the term "part of a ring" relates to an atom or group bonded to other atoms or groups to form a ring system. Moreover, U.S. Patent

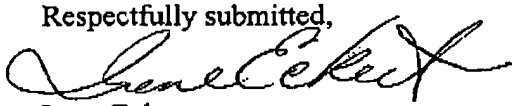
No. 6,812,342 is classified in subclass 536/26.11, and Figs. 2 and 3 of the '342 patent depict a phosphorus group forming part of a ring structure (i.e., bonded to other atoms or groups in a ring). Thus, the term "part of a ring" or group is understood by one of ordinary skill in the art, and by the PTO, to mean an atom or group that is bonded to other atoms or groups to form a ring system. Since one of ordinary skill in the art would understand the scope of the term "part of a ring", claims 1-30 are definite.

The other components, as described in the specification, are not limitless and assist in defining a charge transport compound. One skilled in the art would understand that neighboring R groups, e.g. R_4 and R_5, could form a ring structure, dependent upon the structures of R_4 and R_5 and the particular synthesis reaction. Further, dependent upon the basic structure and branches, an R group could form a ring structure with one of these structures. A person skilled in the art would understand that the term "part of a ring" relates to an atom or group bonded to other atoms to form a ring system. The specification does not preclude the formation of such a ring incorporating one of the R groups selected from R_3, R_4, R_5, R_6, R_7, R_8, and R_9 and structure available in the basic structure/branches. A person of ordinary skill in the art is familiar with organic chemistry and would understand the language of the claim. Therefore, Applicants respectfully request the reconsideration and withdrawal of the rejection of claims 1-30 under §112, second paragraph.

In view of the foregoing, it is submitted that this application is in condition for allowance. Favorable consideration and prompt allowance of the application are respectfully requested.

The Examiner is invited to telephone the undersigned if the Examiner believes it would be useful to advance prosecution.

Respectfully submitted,



Irene Eckert
Registration No. 52,848

Customer No. 24113
Patterson, Thuente, Skaar & Christensen, P.A.
4800 IDS Center
80 South 8th Street
Minneapolis, Minnesota 55402-2100
Telephone: (612) 252-1541

US PATENT SUBCLASS 536 / 26.11
.~.~.~.~.~ The phosphorus is part of a ring

Current as of: June, 1999
Click HD for Main Headings
Click for All Classes

Go To

Internet Version by PATENTEC © 1999 Terms of Use

536 /	HD	ORGANIC COMPOUNDS – PART OF THE CLASS 532-570 SERIES
*	DD	ORGANIC COMPOUNDS (Class 532, Subclass 1) {1}
1.11	DF	.~ Carbohydrates or derivatives {15}
18.7	DF	.~.~ Nitrogen containing {13}
22.1	DF	.~.~.~ N-glycosides, polymers thereof, metal derivatives (e.g., nucleic acids, oligonucleotides, etc.) {12}
26.1	DF	.~.~.~.~ Phosphorus containing N-glycoside wherein the N is part of an N-hetero ring {9}
26.11	➧	.~.~.~.~.~ The phosphorus is part of a ring {2}
26.12	DF	.~.~.~.~.~.~> The N-hetero ring is part of a purine ring system {1}
26.14	DF	.~.~.~.~.~.~> The N-hetero ring is a diazine or a diazole ring, including hydrogenated

Go To

DEFINITION

Classification: 536/26.11

The phosphorus is part of a ring:

(under subclass 26.1) Compounds wherein the phosphorus is part of a ring structure.

(1) Note. Examples of compounds provided for herein are: [figure]

US PATENT SUBCLASS 536 / 26.11-- .~.~.~.~.~ The phosphorus is part of a ring

EXAMPLES

Organic Chemistry

Kosmoi.com > Science > Chemistry > Organic:

Organic chemistry is the branch of chemistry concerned with the study of carbon-containing molecules known as organic compounds. (except carbon dioxide and monoxide. Although there is an overlap with biochemistry, the latter is the specific study of the molecules made by living organisms.

Some of the classes of substances studied in organic chemistry include: allphatic compounds which deals with chains of carbon which can be modified by functional groups; aromatic compounds which are compounds having a benzene ring or similar group; heterocyclic compounds, compounds which include non-carbon atoms as part of a ring structure; physiologically active compounds which have an effect on the human body; and polymers - long chains of repeating groups.

Aliphatic compounds

Hydrocarbons -- Alkanes -- Alkenes -- Halogenoalkanes - Alcohols -- Ethers -- Aldehydes -- Ketones - Carboxylic acids -- Esters -- Carbohydrates -- Alicyclic compounds -- Amines -- Amides -- Amino acids

Aromatic compounds

Arenes or Aromatic hydrocarbons -- Benzene -- Aromatic amines -- Phenols

Heterocyclic compounds

Pyrrole -- Porphyrin -- Chlorin -- Corrin

Physiologically active compounds

Polymers

Polymer -- condensation polymer

Concepts

Organic nomenclature -- Chemical formula -- structural formula -- skeletal formula --Organic reactions

History

For some time it was believed that organic compounds could be produced only by living organisms (hence the name) until the synthesis of urea by Friedrich Wöhler in 1828.

Characterisitics of organic substances

The reason that there are so many carbon compounds is that carbon has the ability to form many carbon chains of different lengths, and rings of different sizes. A lot of carbon compounds are extremely sensitive to heat, and generally decompose below 300'C. They tend not to be so soluble in water compared to many inorganic salts. In contrast to such salts, they tend to be much more soluble in organic solvents such as ether or alcohol. Organic compounds are covalently bonded.

The Cell Wall

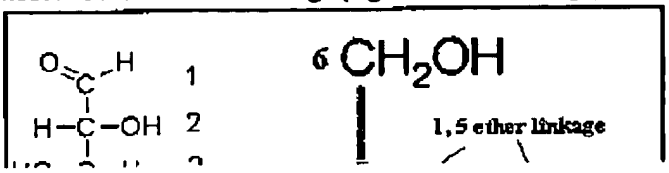
A Spoonful of Sugars

Terms defined on this page:	
anomer	**hemiacetal**
enantiomer	**hydroxyl group**
furanose	**ligand**
glucan	**mannose**
glucose	**polysaccharide**
glycoside	**pyranose**
Haworth diagram	**stereochemistry**
These would be on the test, if we gave one.	

Since we haven't done this elsewhere, it's time we provided the rudiments of sugar (saccharide) chemistry, so that we can make useful noises about *polysaccharides* (sugar polymers) -- easily the most common class of biopolymers on the planet. A more extensive and far better introduction may be found at **Natural Products**.

All sugar monomers of biological importance have structural formulas which looks something like this: $CH_2OH\text{-}(CHOH)_n\text{-}CHO$. In other words, they consist of a chain of carbon atoms, in which each carbon atom has a *hydroxyl* (-OH) group attached to it, except for C1 (sometimes C2) which has an aldehyde or keto (=O) group. In living organisms, the chain is generally 3-7 carbons long. In biologically important polysaccharides, the monomers are almost always 5- or 6-carbon sugars.

We have only reluctantly provided a reference graphic of a sugar monomer in linear form because, in life, 5- and 6- carbon sugars rarely occur as straight chains. The carbon atoms with the aldehyde (or keto) group reversibly bonds to one of the other carbons by "sharing" a hydroxyl oxygen, forming a C-O-C linkage. This is known as an *hemiacetal* linkage. Typically, the result is a 5- or 6-member ring -- four or five carbon atoms plus the linking oxygen. A five-member form (*e.g.* a C1→C4 linkage) form is called a *furanose*. A six-member ring (*e.g.* C1→C5 linkage) is a *pyranose*. A simple example, and perhaps the most common sugar monomer, is *glucose*. Its usual (pyranose) ring form is shown in the image. It can also occur as a furanose.



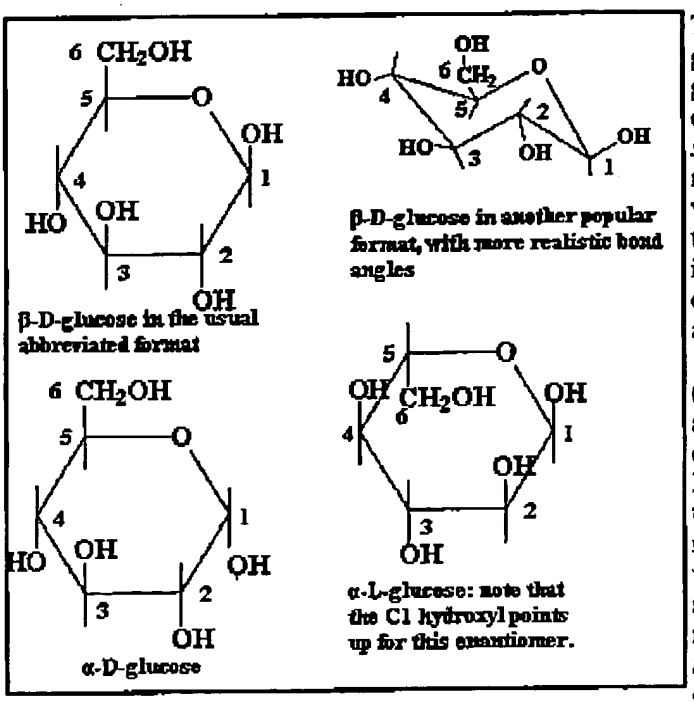
In fact, the two forms are in equilibrium.
Under biologically relevant conditions, the equilibrium so strongly favors the pyranose form of glucose that we can ignore the furanose. However, this is not necessarily the case for all sugars.

This is also the last time we will show the ring carbons. By the universal convention of biochemists, carbon atoms forming part of a ring structure are not shown with a 'C' symbol. They are simply indicated by the intersection of the bonds from the various groups (*ligands*) to which the carbon atom is attached. Very frequently, hydrogen ligands (H-) are not shown either. A line with nothing at the end means a hydrogen ligand, and an unlabelled intersection of bonds means a carbon atom. See examples below.

Sugar monomers are not always quite this simple. Each of the hydroxyl ligands is moderately chemically active, and all kinds of variants exist. An example, of particular relevance to fungi, is chitin. Chitin is a polymer of N-acetly-2-glucosamine, *i.e.*, a glucose derivative in which the ligand CH_3-CH_2-NH- substitutes for the OH-group on C2. See the *chitin* glossary entry for an image.

In most of these examples, we have shown the structure of sugars using a *Haworth Diagram*. These are easy to draw and to understand, but they are rather crude tools because the bond angles are grossly distorted. Carbon normally forms tetrahedral structures, with the bonds about 108° apart. However, Haworth diagrams will do for our purposes, so long as we don't take them too seriously.

Stereochemistry



The figure above is labeled "D"-glucose for an important reason: it gives us an excuse to discuss three quick points about *stereochemistry*. Stereochemistry relates to the properties of compounds which are chemically identical, except that they are asymmetrical, and differ in the arrangement of ligands about one or more asymmetrical backbone atoms.

(1) Note that carbons 1 through 5 are asymmetrical in glucose. Each of these carbons is attached to four *different* ligands. Thus, the relative positions of the groups attached to the carbon atoms makes a difference. If, for example, we flipped the hydroxyl group on C2 so that it was *above* the ring, this would no longer be glucose. It would be *mannose*, a sugar with rather different chemical properties.

(2) If we took the mirror image of the *entire* molecule, all of the bonds would be in the same

relative position. Thus we would have a molecule that ought to have exactly the same chemical properties as glucose, which it does -- sort of. The difficulty is that, when this reversed glucose interacts with some other asymmetrical biochemical, the two molecules no longer mesh in the same way. Consequently, we must distinguish between **D**-glucose and its mirror image (*enantiomer*), **L**-glucose. Don't worry about telling the difference. The biologically relevant form for sugars is usually the **D**-enantiomer. You can assume a figure shows the **D**-enantiomer unless someone tells you differently.

(3) C1 is a special case. In the linear form, C1 is not asymmetrical because it has only three ligands. However, when the C1 forms a pyranose linkage to C5, it becomes asymmetrical. In terms of our diagram, the -OH group on C1 might point down or up. Free glucose in solution is, once again, in equilibrium between the two forms, referred to as α- and β-D-glucose. These alternate forms of the hemiacetal are referred to as *anomers*. However, this time, neither form is strongly favored. (This is also not like the glucose-mannose example, since the two forms freely interconvert.) For free glucose, the exact form at any given time is unimportant. However, when glucose is linked to another sugar through the C1 hydroxyl group, the conformation becomes "frozen." Consequently, for glucose *polymers*, we need to distinguish between α (hydroxyl down) and β (hydroxyl up) linkages (*glycoside bonds*). Incidentally, the alpha-down/beta-up convention is reversed for **L**-enantiomers or, naturally enough, when the sugar monomer is represented upside-down.

General Features

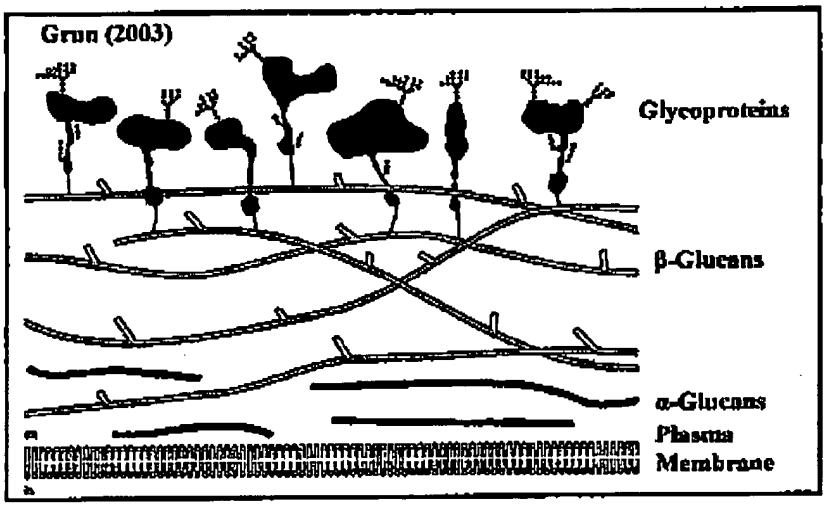
Fungal cells maintain a very high turgor pressure, so the integrity of the cell wall is a critical matter. Cabib *et al.* (2001). The composition of the fungal cell wall is rather variable. The variability appears to have phylogenetic significance, but few, to our knowledge, have followed that trail (*but see* Grum, 2003). In general, mycology has leapt directly from the ponderous fallacies of classical typological systematics to the facile, but sometimes equally fallacious, paradigms of molecular systematics. Consequently, there is remarkably little honest biology and biochemistry being applied to phylogenetic issues.

The situation is not improved by the usual non-specialist texts which characterize the fungal cell wall as a relatively simple structure made up of "cellulose" and chitin. Consider that the fungal cell wall can make up 30% or more of the dry weight of the fungus, and that the fungi are characterized by external digestion of food followed by selective absorption of the digestion products. Clearly, we can expect that the fungal cell wall will be a complex, specialized system.

It is all that; and, in addition, it is a highly dynamic system, constantly being regenerated and remodeled according to the needs of the moment. Adams (2004). Thus, many of the cell wall-associated proteins are enzymes whose function is to hydrolyze chitin and polysaccharides. The lesson is that this type of cell wall is, from a metabolic point of view, very different from insect exoskeletons or a plant cell walls, which are terminally differentiated structures.

Not unexpectedly, attempts to understand the biosynthesis of cell wall components have run into a maze of regulatory pathways which are difficult to sort out. García *et al.* (2004) applied brute force genomics methods to analyze gene responses to several different physical and chemical agents affecting cell wall integrity. The genetic responses in each case involved on the order of 100 different genes, with a significant different cohort of genes activated by each agent. Similarly, Lesage *et al.* (2004) identified 135 genes involved in the synthesis and regulation of the β-(1→3)-glucan component (*see infra*) alone (*see also* several similar studies cited by these authors). In fact, it has been estimated that 20% of the *Saccharomyces* genome is involved with cell wall biosynthesis. Durán & Nombela (2004). Some efforts are being made to pare these lists down to some "core" group of pathways. However, the magnitude of the problem has only become clear in the last few years, and it is much too early to say anything useful.

Structure



We include two diagrams of the fungal cell wall by Grün (2003) and Cabib *et al.* (2001). We've also thrown in Joan Miró's (1940) *Chiffres et Constellations* just because it has somewhat the same feel to it.

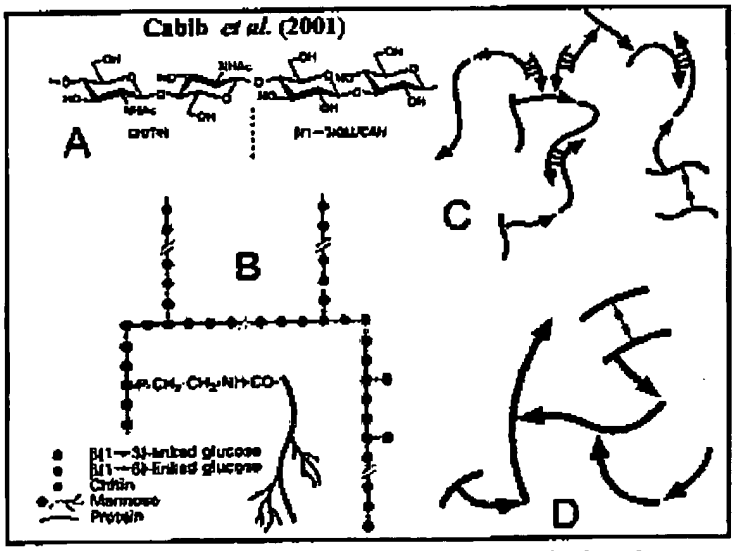
While each of these images speaks to us in its own way, we will work primarily with Grün's concept. The cell wall is generally constructed of three layers: (1) an α-glucan layer (a *glucan* is a polymer of glucose), (2) a β-glucan layer, and (3) an outer layer of glycoprotein. In addition, *chitin* may be a significant component of certain cell wall structures.

The α-glucan layer, if present, is generally composed of the α(1→3)-glucan polymer. However, α (1→4) glycosides are variably present. *Compare* glycogen, which is α(1→4)-glucan with (1→6) side chains. Where present, the α-glucan material appears as a fibrillar layer adjacent to the plasma membrane and is thought to serve a largely structural role, stiffening the basal layer of the cell wall.

The α-glucan layer is rarely represented in diagrams of the fungal cell wall because it does not occur in *Saccharomyces*, which is the usual model system. In fact, it has a rather peculiar

phylogenetic distribution. Among ascomycetes, the alpha glucan is found in *Schizosaccharomyces*, but is not known from any other yeasts. The material is common among all groups in the Pezizomycotina. However, in Lecanoromycetes, a very large proportion tends to be in the α(1→4) form. Alpha glucans also form a significant, sometimes even dominant, part of the cell wall in many basidiomycetes, but are completely absent outside the Hymenomycetes. Grün (2003). Although *Schizosaccharomyces* is often classified with the yeasts, its position is probably more basal. A number of studies show it branching with (paraphyletic) taphrinomycotines. *See, e.g.*, Liu *et al.* (1999), An *et al.* (2002). We tend to prefer the methodology of these studies, which are neither biased by the superficial similarities of "yeast" forms nor confused by the usual problems with *rDNA* and *mtDNA*. Thus, it appears likely that the alpha glucan layer is primitive for all higher fungi, or at least for Ascomycota, with subsequent multiple losses.

The bulk material of the cell wall is usually in the form of β(1→3)-glucan. This forms a very stable hydrogen-bonded triple helix in solution, and probably *in vivo*. The packing of these triple helix structures appears to be controlled by the size and frequency of very short (1→6) side chains, sometimes consisting of only a single glucose monomer. Grün (2003). If so, this clearly provides a method for controlling the structure and conformation of the cell wall very simply and with very fine, localized control. However, essentially no work appears to have been done in this area. If anyone out there is looking for a potentially elegant and informative dissertation topic in a virtual research vacuum, this is it.



In addition to β(1→3)-glucan, the cell wall contains β(1→6)-glucan. We emphasize that this is not simply a β(1→3)-glucan with big side-chains, but a polysaccharide with a true β(1→6) backbone. This material may be peripheral to the bulk β(1→3)-glucan and is, in any case, strongly involved in cross-linking the various components of the cell wall, as shown in the figure from Cabib *et al.* (2001).

The outermost layer of the cell wall is composed of diverse proteins bearing polysaccharide side chains composed of mannose. The usual explanation is that these are attached through their mannan side

chains via a (1→3) linkage with the β(1→6)-glucan. However, this is only a model. Real life appears to be very much more complex, involving a wide variety of different interactions between glycoproteins and bulk cell wall materials. Pitarch *et al.* (2002).

Finally, the fungal cell wall contains variable amounts of *chitin*. In many systems chitin is a major constituent of the cell wall. In others, it is involved only in cell division or reproductive structures and is virtually absent otherwise. Again. we are reluctant to say much about it, absent more detailed, phylogenetically-grounded studies of the actual ultrastructure in particular cases.

In general, the study of the fungal cell wall tends to be strong on models and somewhat weaker on data. One virtue of the brute force genomic and proteomic studies now being produced is that they clearly confront us with the scope of the problem. Fungal cells probably lack the diversity of metazoan tissues. However, each fungal cell must, for that very reason, be competent to perform a much wider variety of functions than a typical terminally-differentiated metazoan cell. Consequently, their superficial similarity and simplicity are likely to mask a very complex, plastic biochemical repertoire. Perhaps, after all, the Miró is the best representation, given the current state of our knowledge. ATW051113.

Page Back | Page Top | Unit Home | Page Next